Morphology Of Flowering Plants

- Angiosperm — characterised by → stems, leaves, flower, fruits
  - Underground part of flowering plant → Root system
  - Portion above ground → Shoot system

★ flowering plants show enormous variation in shape, size, structure, mode of nutrition, life span, habit & habitat

THE ROOT

★) Dicotyledonous plants → direct elongation of radicle leads to formation of Primary Root → grows inside soil → bears Lateral roots of several orders referred to as sec. roots, terf. roots

Primary root + its branches constitute **Tap Root system.**
- In mustard.

★) Monocotyledonous plants → Primary Root
- Short lived
- Replaced by a large no. of roots.

these roots originate from Base of the Stem

Eg Wheat → Fibrous Root system

★) Adventitious Roots → Roots arise from parts of plant other than radicle
- Grass
- Monesteria
- Banyan

Main function Of Root system

- Absorption of water & minerals from soil
- Providing proper anchorage to plant parts
- Store reserve food material
- Synthesise PGR.

REGIONS OF ROOT

Root covered by Apex by Thimble like struct. ROOT CAP. protects Tender apex of root as it makes it way to soil

Meristematic Zone	Elongation Zone (proximal to meristem.)	Maturation Zone (proximal to elong.)
• Few mm above root cap • Cells – very small, thin walled, dense cytoplasm/protoplasm. Divide repeatedly	• Proximal to meristem. region. • Cells – undergo rapid ① elongation ② enlargement. • responsible for growth of root in length	Elongat. zone cells differentiate and mature give rise to From this region → some epidermal cells form ① fine ② thread like ③ delicate Root hairs absorb water & mineral

MODIFICATION OF ROOTS

Roots → change shape & structure → & becomes modified to perform other functions than absorption & conduction of water & minerals

modified for → • Support • Storage of food → Asparagus • Respiration

Tap Roots

- Get swollen
- Store food
  - carrot
  - turnip

Adventit. Roots

- Get swollen
- store food
  - Sweet potato

Prop Roots

- Banyan tree – hanging structures
- Support

Stilt Roots

- Stem of → maize, Sugarcane → have supporting roots coming out of lower nodes of stems

Some plants of Arid region → modify stem → flattened – opuntia; cylindrical – Euphorbia

* They contain chloroplyl & carry out photosynthesis.

PNEUMATOPHORES

- Swampy area
- Roots come out of ground vertically upwards.
- help to get oxygen for respiration

THE STEM

+very phototropic
Generally green, later often becomes → woody, dark brown
has multicellular hairs

Ascending part of axis bearing → branch, leaves, flowers, fruits

develops from plumule of embryo of germinating seed.

Bears bud → Terminal, Axillary

node → leaves are born

internodes → b/w two nodes

- Main funct. of stem – spreading out branches bearing leaves, flowers, fruits
  - Conducts → water, mineral, photosynthates
  - Function for → storage of food, Support, Protection, Veg. propagation

- Modification of Stem

Underground stem of → Potato, Ginger, Zamikand, Colocasia → modified to Store food in them.

Act as organ of perennation & to tide & cond. unfav. for growth.

Stem tendrils

- Slender
- Spirally coiled
- helps plants to climb
  - ① cucumber
  - ② pumpkin
  - ③ watermelon
  - → gourds
  - → grapevine

Axillary Buds

develops → Thorns

- Woody
- Straight
- pointed
- They protect plants from browsing animals

Bougainvillea

Underground stems of some plants spread to new niches & when older parts die, new plants are formed.

- grass
- Strawberry

★ Stem may not always be typically what they are expected to be. They are modified to perform different function.

Lateral branches originate from
① Basal & underground portion of main stem. Grows horizontally beneath the soil. Come out obliquely upwards giving rise to leafy shoots.
- Banana
- Pineapple
- Chrisanthemum

Lateral branch with short internodes & each node bearing a rosette of leaves & tuft of roots found in aquatic plants
- Pistia
- Eichhornea

① Slender lateral → branch arises from the base of main axis & after growing aerially for sometime arches downwards to touch the ground.
- Mint
- Jasmine

THE LEAF

★ Lateral outgrowth of stem develops exogenously at node. → develops into branch later

born on stem
Lateral
Flattened
originate from → Shoot apical meristems → and → acropetal order
develops at node & bears bud in its axil → axillary bud

LEAF — typically 3 parts
① Leaf base
② Petiole
③ Lamina
★ Leaf are most imp vegetative organs for photosynthesis.

may have → 2 lateral small → leaf like structures → called → STIPULES

Leaf attached to stem by → Leaf base
- → In monocot → Expand into a sheath covering the stem partially or wholly
- → In some leguminous plant → becomes swollen → called → Pulvinus

Petiole → help hold the blade to light.
- Long
- Thin
- Flexible

petiole allow → leaf to flutter in wind → thereby
① cooling the leaf
② Bringing fresh air to leaf surface

Veins provide
- → rigidity to leaf blade
- → Act as channels to transport → water → minerals / food materials

Midrib — known as → A middle prominent vein

Lamina / Leaf blade → • Green • Expanded part of leaf → with
① Veins
② Veinlets

Varies in different leaves.
- Shape
- Margin
- Apex
- Surface area
- Extent of incision of lamina

• Arrangement of veins / veinlets in lamina of leaf ← VENATION

Reticulate
Veinlets form a network
Eg. Dicotyledonous plants

Parallel
Veins run parallel to each other within a lamina
Eg. most monocot plants

TYPES OF LEAVES

Date ___/___/___
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Simple leaves → ★ Lamina is entire OR when incised, the incisions do not touch midrib

Compound leaves → When incision of lamina reach midrib breaking it into a no of leaflets.

In both, bud present in axil of petiole but not in axil of leaflets

Pinnately Comp.
No. of leaflets on a common axis → Rachis (represents midrib of leaf)
Eg. NEEM

Palmately Comp
Leaflets attached to common point i.e at tip of petiole
Eg. SILK COTTON

PHYLLOTAXY

→ Arrangement of leaves on → Stem / Branch

Alternate	Opposite	Whorled
• Single leaf arises at each node in alternate manner	• Pair of leaves arise at each node & lie opp. to each other.	More than 2 leaves arise at each node & form a whorl.
China rose, mustard, sunflower	calotropis, Guava	Alstonia

MODIFIC. OF LEAVES

★ Leaves are often modified to perform funct. other than photosynthesis.

Modified leaves of:

- **Pea** → • tendrils (support)
- **Cacti** → • spines (leaves) (protection)
- **Australian acacia** → • Leave → small, short lived; • Petiole → expand → become green & synthesize food.
- **Insectivorous plants** → • pitcher plant, • Venus fly trap
- **Garlic, Onion** → • Fleshy leaves – store food

Flower → Modified shoot ① where shoot apical meristem changes to floral meristem
② Internodes do not elongate & ③ axis gets condensed.

Apex produces – different kinds of floral appendages laterally at successive nodes instead of leaves.

Inflorescence – Arrangement of flowers on the floral axis.

Basis – whether the apex gets developed into a flower or continues to grow.

★ When a shoot tips transforms into a flower, it is always solitary

Racemose
Main axis → continue to grow
Flowers born → ① Laterally ② Acropetal order

Cymose
Main axis → terminates in a flower
∴ Limited growth
Flowers born in → basipetal order

THE FLOWER → reproductive unit in flowering plants (angiosperms)

→ meant for sexual repro.

↓ has 4 whorls ↓ on
- calyx, corolla → accessory organs
- Androecium, Gynoecium → reproductive organs

Swollen end of stalk/Pedicel → Thalamus/Receptacle

Calyx & corolla not distinct ↓ PERIANTH ↓ Lily

Bisexual has both → Androecium, Gynoecium

Unisexual has either ↑ Androecium OR ↓ Gynoecium

⊙ **Actinomorphic** → Radial Symmetry ↓ Flower can be divided into two equal radial haves by any radial plane passing through centre. → Mustard, Datura, Chilli

⊙ **Zygomorphic** → Bilateral Symmetry ↓ When flower can be divided into 2 halves by only one particular vertical plane → Pea, bean, Gulmohar, Cassia

⊙ **Assymetric** → Can't be divided into 2 halves by any vertical plane passing through centre. (Irregular) → Canna.

☆ Flower
- Trimerous → floral appendage in multiples of → 3
- Tetramerous → 4
- Pentamerous → 5

with bracts → Bracteate; without bracts → Ebracteate → Reduced leaf found at base of pedicel

Based on position of Calyx, Corolla & Androecium w.r.t. the ovary on the thalamus

HYPOGYNOUS
Gynoecium – highest position
Other parts – below Gynoecium
Ovary – superior

mustard, China Rose, Brinjal

PERIGYNOUS
Gynoecium – at centre
Other parts – on rim of thalamus almost at same level
Ovary – half inferior

Peach, Plum, Rose

EPIGYNOUS
Margin of thal amus growing upward enclosing the ovary completely & getting fused with it, other parts of flower arise above ovary.
↓ inferior

guava, cucumber, Ray florets of sunflower

PARTS Of a Flower

Calyx, corolla, Androecium, Gynoecium → 4 whorls

Calyx → Sepals → green, leaf like, protect the flower in bud stage
Outermost whorl of the flower.
→ Gamosepalous → sepals united
→ Polysepalous → sepals free

Corolla composed of Petals (Bright coloured to attract insects for pollination.)
→ Gamopetalous (united petals)
→ Polypetalous (free petals)

★ The shape, colour of corolla vary greatly in plants.
★ Corolla may be → tubular, bell shaped, wheel shaped, funnel

AESTIVATION → Mode of arrangement of sepals / petals in a floral bud w.r.t other members of same whorl.

Vexillary / Papilionacious
5 petals
- standard → largest one
- lateral (wings) → 2
- keel → smallest anterior petals → 2 (covers)

Pea, Bean

Imbricate
Margins of sepals / petals overlap but not in any particular direction
Cassia, Gulmohar

Twisted
If margin of appendage overlaps that of next one.
China Rose, Lady finger, Cotton

Valvate
- No overlapping
- Just touch one another at margin.

Calotropis

ANDROECIUM composed of Stamens (represents male reproductive organ.) consists of
- Anther → Bilobed (2 lobes), (2 chambers) in each lobe (Total – 4) → Pollen sacs → pollen grains produced in it.
- Stamen / Filament

★ Stamens of flower may be with → other members / among themselves
Sterile Stamen → Staminode

Stamen attached to
- Petals → Epipetalous → Brinjal
- Perianth → Epiphyllous → Lily

Stamens:
- Free → polyandrous
- United in varying degrees
  - Monoadelphus → united in one bunch → China Rose (Gudhal)
  - Diadelphus → 2 bundles → pea
  - polyadelphus → more than 2 bundles → citrus

⊙ Variation in the lengths of filament within a flower → Salvia, mustard

Apocarpus ← More than one carpel → Syncarpous → fused carpels

Free (lotus carpel) Rose — Mustard, Tomato

Gynoecium (female reproductive part) made of (1 or more) Carpels

- Stigma → Tip of style (Receptive surface for pollen grains)
- Style → elongated tube
- Ovary → enlarged basal part → bears → 1 or more ovules

Placenta → attached to flattened cushion like

After fertilization → ovules → seed, ovary → fruit

PLACENTATION → Arrangement of ovules within ovary

- **Marginal** → Placenta forms ridge forming 2 rows → Pea
- **Axile** → ovules attached to it in a multilocular ovary → china rose, Tomato, lemon.
- **Parietal** → ovules develop on → inner wall of ovary OR peripheral part → Argemone, mustard
  - Ovary – one chambered → becomes Two chambered (due to form. of false septum) REPLUM
- **Free central** → Ovules born on central axis & septa absent → Dianthus, Primrose.
- **Basal Placentation** → Placenta → at base of ovary; Single ovule attached to placenta → sunflower, marigold.

FRUIT → characteristic of flowering plants

→ mature / ripened ovary → developed after → fertilization

→ If fruit formed without fertilization of ovary — Parthenocarpic fruit (banana)

Fruit consists of → Wall / Pericarp may be → dry OR fleshy

When pericarp thick & fleshy → differentiated into → outer Epicarp, middle Mesocarp, inner endocarp

- Outer Epicarp: • thin
- Mesocarp: • Fleshy • Edible
- Endocarp: • hard • inner • stony

Coconut → Mesocarp – fibrous

Mango & Coconut → Drupe → develop from → Monocarpellary superior ovary

- Mango → pericarp well differentiated
- one seeded

Seeds in the monocot & dicot vary in → size, shape → viability period

STRUCTURE OF DICOT SEEDS

Ovules → seed (in general seed.) made of → seed coat, Embryo made of → radicle, Embryonal axis, Cotyledon → 1 → wheat, maize; 2 → Gram, pea

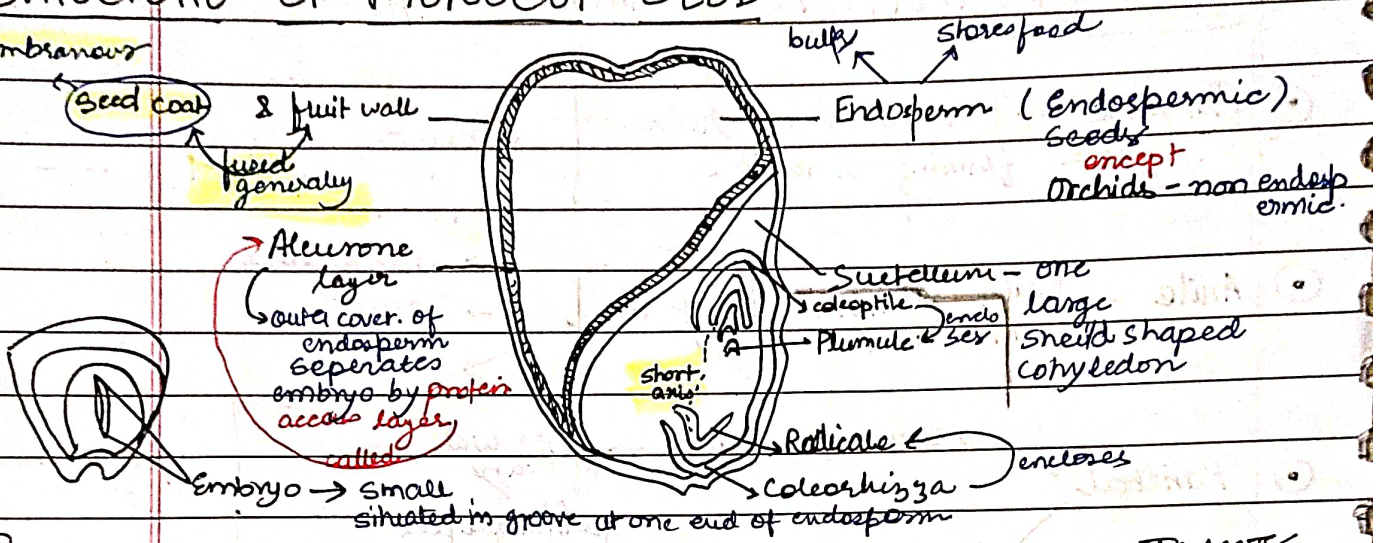
outermost covering of seed → Seed coat (2 layers: outer → Testa, inner → Tegmen) within it → Embryo consists of: Embryonal axis (at 2 ends → plumule, radicle) & 2 cotyledons (• Fleshy • Full of reserve food)

Hilum (scar on seed coat) through which developing seeds were attached to fruit.

Micropyle (small pore) above

Non endospermous (dicots) → bean, Pea, Gram (Except castor)

STRUCTURE OF MONOCOT SEED



SEMI-TECHNICAL DESCRIPTION OF A TYPICAL FLOWERING PLANTS

★ flowering plant is described in a definite sequence by using scientific terms.

P - Perianth	C - Corolla	K - Calyx	Br - Bracteate
$\underline{G}$ - infer. ovary	$\underline{G}$ - Superior ovary	G - Gynoecium	A - Androecium
⊕ - actinomorphic	% - zygomorphic	♂ - bisexual	♀ - female, ♂ - male

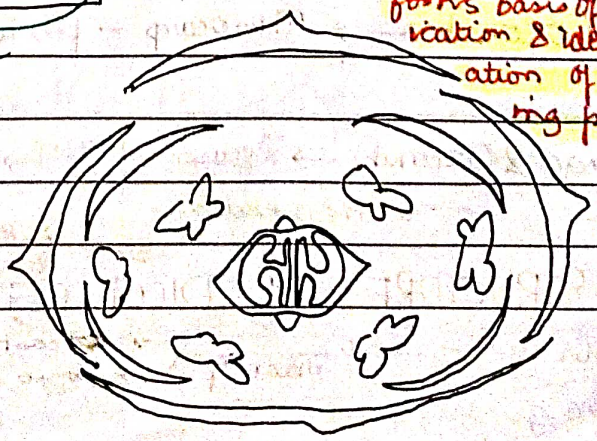
Fusion indicated by enclosing the figure within bracket ( )

Adhesion - by line above symbols of floral parts

also show → cohesion → within parts of whorls; adhesion → b/w whorls.

- Floral diagram provides inf. about → The no. of parts of flower. → Their arrangement & relationship with one other
- Position of mother axis w.r.t flower. — represented by → Dot on top of flower diagram
- Calyx → corolla → androecium → gynoecium — drawn in successive whorls
- Calyx: outermost; gynoecium: innermost

★ Floral characteristics forms basis of classification & identification of flowering plants.

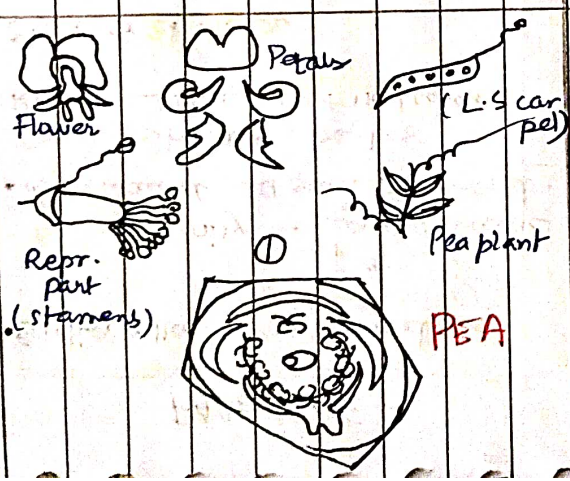


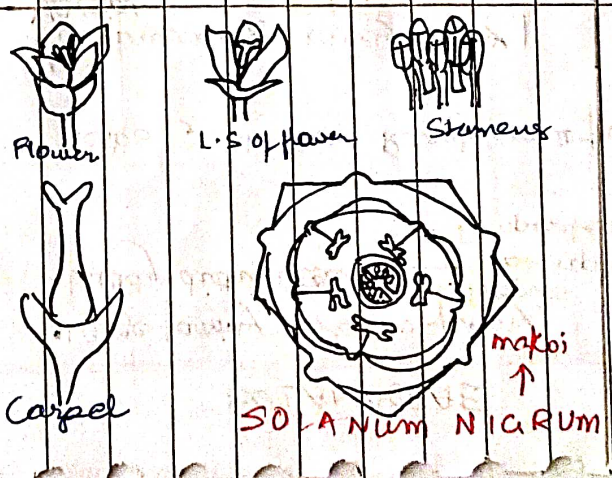
Mustard family - Brassicaceae

⊕ ♀ $K_{2+2}\ C_4\ A_{2+4}\ \underline{G}_{(2)}$

FAMILY	FABACEAE	SOLANACEAE	LILIACEAE
Short description.	• Earlier called – Papilionideae (a sub family) ↓ of Family – Leguminosae. • Distributed all over the world.	• Large family – Potato family • Widely distributed in → Tropics, Sub-tropics, Temperate zones	• Commonly called – Lily family ★ Characteristic representative of monocotyledonous plants. • Distributed world wide.
Veget. Characters Stem –	Trees, shrubs, herbs Roots – with → root nodules Erect or climber	Herbs, shrubs, Rarely small trees ★ Herbaceous, rarely woody ★ Aerial ★ Erect ★ Cylindrical ★ Branched ★ Solid or hollow ★ hairy or glabrous • Underground stem Potato.	★ Perennial herbs – with → Underground → bulb, corms, Rhizome.
Leaves –	Alternate Pinnate → comp OR simple • Leaf base pulvinate ★ stipulate • Reticulate	Alternate Simple Rare – pinnately comp. ★ Enstipule • Reticulate	Alternate mostly basal linear ★ enstipulate • Parallel venation
Floral characters Inflorescence.	Racemose	Cymose → solitary, axillary } → as in Solanum.	Solitary / Cymose (umbellate cluster)
Flower	Bisexual, Zygomorphic	Bisexual, actinomorphic	Bisexual, actinomorphic
Calyx	Sepals – 5 Gamosepalous Valvate / Imbricate aestivation	Sepals – 5 United Persistent Valvate aestivation	Perianth – Tepals – 6 (3+3) United → tube Valvate aestivation
Corolla	Petals – 5 Polypetalous Papilionaceous → ★ posterior standard, 2 lateral wings, 2 anterior ones ↓ forming Keel (enclosing stamens pistil) Vexillary aestivation	Petals – 5 United Valvate aestivation	corolla, calyx
Androecium	10 diadelphous Anther – dithecous	5 epipetalous	6 (3+3) Epipetalous

	1	2	3
Gynoecium	Ovary - superior Monocarpellary Unilocular many ovules Single styles	Bicarpellary Obligately placed Syncarpous Ovary - superior Bilocular Placenta - swollen - with many ovules	Tricarpellary Syncarpous Ovary - superior Trilocular with many → ovules Placentation - axile
Fruits	Legume → seed - one to many Non-endospermic	Berry or capsule	Capsule / Rarely berry.
Seeds	1 to many Non endospermic	many Endospermic	Endospermic
Floral formula:	% ♀ $K_{(5)}$ $C_{1+2+(2)}$ $A_{(9)+1}$ $\underline{G}_1$	⊕ ♀ $K_{(5)}$ $C_{(5)}$ A_5 $\underline{G}_{(2)}$	Br ⊕ ♀ $P_{(3+3)}$ A_{3+3} $\underline{G}_{(3)}$
Economic Importance	• Source of pulses → gram, arhar, sem, moong, soyabean • Edible oils → groundnut, soyabean • Dye - Indigofera • Fibres - sunhemp Fodder → Sesbania, Trifolium Ornamental → lupin, sweetpea Medicine → muliathi	Source of food → tomato, brinjal, Potato Spice - chilli Medicine → belladona, ashwagandha. Rumigatory → tobacco Ornamentals - petunia	Good ornamentals → tulip, Gloriosa Medicine - Aloe Vegetables - Asparagus Colchicine - Colchicum autumnale





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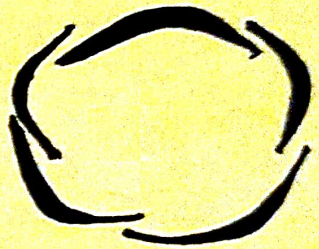
➡ Stalk - Pedicel

Thalamus - Receptacle

* Castor has → Caruncle

Q. When one of petals or sepals is outer, one is inner & others are partly outer partly inner, this cond. is →

IMBRICATE



* Aril — Litchi